

**Gas Supersaturation Monitoring Report
for Spill Below Bonneville Dam
March 12-15, 2002**

U.S. Fish and Wildlife Service
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Introduction

To aid the downstream survival of about 7.9 million tule fall chinook juveniles scheduled for release from the Spring Creek National Fish Hatchery on March 11, 2002, State, Tribal, and Federal Salmon Managers requested in System Operational Request (SOR) 2002-01 that the Action Agencies (Bonneville Power Administration, U.S. Corps of Engineers, and the Bureau of Reclamation) provide spill levels at Bonneville Dam (RM 146) starting at 80 thousand cubic feet per second (Kcfs) and increasing to 100 Kcfs, at a discharge equal to 170 Kcfs. The operation was requested for a five to ten day period following the release, with a check in after five days. The increase in flow was requested to provide sufficient depth for total dissolved gas (TDG) compensation over listed chum redds below the Bonneville project. It was calculated by biologists with the U.S. Fish and Wildlife Service (USFWS) that the requested level of flow and spill would produce a maximum TDG level not exceeding 120% in the tailrace of Bonneville Dam and a maximum TDG level not exceeding 105% above the chum and fall chinook salmon redds below Bonneville Dam at the Ives Island complex and across the river along the Oregon shore (Figure 1).

After significant discussion at the Technical Management Team and the Implementation Team, the Action Agencies did not agree that the SOR was implementable and agreed to provide an alternative operation for slightly less than a three-day period. The Action Agencies agreed to provide 200 thousand acre feet (KAF) of volume above the average flow otherwise provided. Discharge would begin at 150 kcfs from Bonneville with a spill level of 50 kcfs starting March 12, 2002. From 0900 hours March 13 to 1200 hours March 14 discharge would increase to 170 kcfs including an initial spill level of 70 kcfs. Discharge would then go to 150 kcfs with 50 kcfs spill. The Spring Creek spill operation would cease at 0800 hours March 15, 2002 when the 200 KAF is used up. Minimum tailwater elevation of 13.5 feet would be maintained to provide for adequate depth compensation for fish and redds.

The USFWS requested a TDG waiver from the Oregon Department of Environmental Quality and an adjusted dissolved gas standard from the Washington Department of Ecology (WDOE) for spill at Bonneville Dam for a ten day period in March, 2002. These requests were made to allow for TDG saturation up to 115% as measured at the Camas/Washougal monitoring station (RM 122) and 120% in the Bonneville Dam tailrace, as measured at the Skamania and Warrendale monitoring stations (RM 140) on the Washington and Oregon shores, respectively. The Oregon Environmental Quality Commission approved this request at its March 8, 2002 meeting. The WDOE provided

the adjusted TDG standard previously on March 8, 1999. The adjusted TDG standard expires in the year 2003. One of the conditions of the approved waiver and adjusted TDG standard was that the USFWS conduct biological and physical monitoring downstream of Bonneville Dam during the spill period and to provide reports of this monitoring. This report summarizes the results of this monitoring program.

Operations

The Salmon Managers requested that the Bonneville Dam Second Powerhouse (PH2) have first use priority for power generation during the spill period. The Salmon Managers believed that greater use of the second powerhouse would direct water with lower TDG levels along the Washington side of the river where most of the salmon redds were located.

Spring Creek National Fish Hatchery, located along the Columbia River at RM 167.2, released 7.9 million tule fall chinook salmon beginning in the morning and through the early afternoon of March 11.

Flows of 150 kcfs were released from Bonneville Dam starting at 0900 hours on March 12, with a spill level of 50 kcfs. Outflow was increased to 170 kcfs at 1700 hours on March 12 and stayed at or above that level until 1200 hours March 14 when flow was reduced to 150 kcfs. This outflow level continued until the operation ended at 0600 hours March 15. Spill was increased to 70 kcfs at 2000 hours on March 12 and continued until 1300 hours on March 13 when the spill level was raised to 100 kcfs. Spill was reduced to 50 kcfs at 1200 hours on March 14 and continued until 0600 hours on March 15. Tail water was above the 13.5 feet level during the entire operation.

The USFWS Columbia River Fisheries Program Office (CRFPO) monitored water conditions and examined fish collected below Bonneville Dam for signs of gas bubble trauma (GBT) during the March 2002 spill period.

The number of juvenile fish observed passing Bonneville Dam at the juvenile fish facility during and after the spill period is detailed in Table 1 and Figure 2.

Biological Monitoring

The biological monitoring program included collecting at least 100 fish (juvenile salmonids and resident fish) each of two sampling days during the period of spill and examining them for signs of GBT. Sampling was conducted on March 12 and March 13. Personnel from the USFWS who examined fish for signs of GBT had been trained on examination techniques by staff from the Fish Passage Center. Jerry McCann, the Fish Passage Center staff member who trained USFWS staff, also examined fish with CRFPO staff on March 12.

Fish were captured by Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW) personnel using a 100-foot-long beach

seine in near shore areas of the Columbia River and Ives Island (RM 142.5, approximately) side channel at sampling sites that they continuously monitor for emerging and stranded fry. Figure 3 displays the locations of WDFW/ODFW beach seining sites. Biologists used dissection microscopes to examine captured fish for signs of GBT. A minimum of 10x magnification was used for viewing fins. Protocol for GBT exams in 2002 dropped the requirement to examine the lateral line. As in the March 2001 sampling procedure, the same ranking system was used to rank unpaired fins.

Results:

A total of 336 fish were examined for signs of GBT (Table 2). Of this total, 225 fish were examined on March 12 and 111 fish were examined on March 13. The one northern pike minnow captured had signs of GBT in the caudal fin (a single bubble). This equates to an overall incidence level of 0.3%.

Monitoring of Physical Conditions

Biologists from the USFWS used a Hydrolab Minisonde meter to take real time TDG measurements (Table 3) at various locations (Figure 3) from a boat on the Columbia River on March 12 and 13. Water depth data were collected from a depth sensor (gauge 1) deployed at the head of the Ives/Pierce Island side channel. These data were collected and transmitted automatically every other hour for display on the Fish Passage Center's Internet website (www.fpc.org). Individual depth measurements over selected chum redds were hand measured (Table 3).

Results:

Figure 4 displays percent TDG in the Bonneville Dam forebay before, during, and after the spill period. Ambient TDG levels ranged from 101.7-103.3 % during the March 12-15 spill period. Forebay measurements were not available from 1100 hours on March 15 through 0600 hours March 18, well after the spill period ended, but existing data does not suggest a change in the levels of TDG.

Figure 5 shows total discharge and spill at Bonneville Dam before, during, and after the spill period. Total discharge varied from 148-201 Kcfs. Spill volume ranged from 48-100 Kcfs. Tailwater elevations varied from 13.4-17.3 feet, and averaged 15.3 feet from March 12-15. The depth levels recorded by the USFWS pressure gauge 1 near Ives Island during the spill period ranged from 2.9-6.3 feet. During the sampled spill period the depth over the chum redds varied from two feet to more than five feet (Table 3). Compensation for TDG is provided by depth at a rate of about 10% per meter.

Figure 6 compares the TDG readings taken at the USGS sampling stations downstream of Bonneville Dam from March 11 through March 18 (before, during, and after the spill period). None of the readings went above 112.3% during this time period. At the Skamania monitoring station recorded TDG levels varied from 100.3% during non-spill periods, to a high of 107.1% during spill periods. Recorded TDG levels at the Warrendale monitoring station varied from 102.2% during non-spill periods, to a high of 112.3%

during spill periods. Some data were not available from 1900 hours March 15 through 0100 hours March 18 from the Warrendale monitor. This was well after spill ended and interpolation of the data that is available indicates the TDG levels were below 104%. The TDG levels recorded at the Camas/Washougal monitoring station varied from 101.2% from the non-spill periods, to a high of 108.7% from the spill periods. There appears to be about a 12-15 hour travel time for the water mass passing the Skamania and Warrendale monitoring sites to reach the Camas/Washougal monitoring site.

PH2 had first use priority over Powerhouse 1 (PH1) during the March 2002 spill. The TDG levels recorded at Skamania were lower than the TDG levels recorded at Warrendale. These results were similar to those in 2001 and 2000. The new fish bypass system at PH2 allowed for the change of first use priority to PH 2 rather than PH1. In previous years PH1 had first use priority. During the March 1999 spill when PH1 had greater use priority the TDG levels recorded at Skamania were higher than the TDG levels recorded at Warrendale.

Summary

In summary, the USFWS collected and examined fish for signs of gas bubble trauma, and monitored water quality in the mainstem Columbia and over salmon redds during the March 12 to 15 spill period at Bonneville Dam. Biological sampling was conducted on March 12 and 13. Biological monitoring showed that one of the 336 fish that were collected and examined exhibited the lowest level indication of gas bubble trauma.

Total dissolved gas levels recorded at the Skamania and Warrendale monitoring stations near the Bonneville Dam tailrace did not exceed the 120% waiver limit (112.3% actual). The TDG levels recorded at the Camas/Washougal monitoring station did not exceed the 115% waiver limit (108.7% actual).

The fall chinook and the majority of the chum salmon spawning areas along the Ives Island complex are on the Washington side of the Columbia River just upstream of the Skamania monitoring site. First use priority of PH2 over PH1 helps reduce TDG levels along the Washington side of the Columbia River at the Skamania monitoring station when compared to TDG levels recorded for the same time period at the Warrendale monitoring station along the Oregon side of the Columbia River.





Figure 1. Location of salmon redds through December 12, 2001 surveys.  chinook  chum

Table 1. Fish passage index counts at Bonneville Dam, combined subyearling chinook. Index counts were from Power House 2 in 2002, 2001 and 2000. In all other years index counts were from Power House 1.

Number of days into spill start	Spring Creek Release 03/11/02 Index Count	Date	Spring Creek Release 03/08/01 Index Count	Date	Spring Creek Release 03/09/00 Index Count	Date	Spring Creek Release 03/18/99 Index Count	Date	Spring Creek Release 03/13/98 Index Count	Date	Spring Creek Release 03/13/97 Index Count	Date
-1	-----	03/11/02	-----	03/09/01	47	03/08/00	23	03/17/99	50	03/12/98	-----	03/12/97
1	847	03/12/02	-----	03/10/01	139	03/09/00	-----	03/18/99	67	03/13/98	-----	03/13/97
2	17,434	03/13/02	-----	03/11/01	1,228	03/10/00	270,179	03/19/99	68,537	03/14/98	-----	03/14/97
3	367,558	03/14/02	-----	03/12/01	516,102	03/11/00	18,237	03/20/99	97,799	03/15/98	-----	03/15/97
4	187,981	03/15/02	59,454	03/13/01	1,104,556	03/12/00	18,197	03/21/99	29,807	03/16/98	-----	03/16/97
5	158,610	03/16/02	31,679	03/14/01	47,187	03/13/00	5,315	03/22/99	11,368	03/17/98	8,815	03/17/97
6	11,607	03/17/02	18,041	03/15/01	22,308	03/14/00	1,355	03/23/99	9,790	03/18/98	9,054	03/18/97
7	5,645	03/18/02	5,075	03/16/01	7,019	03/15/00	1,197	03/24/99	3,740	03/19/98	5,424	03/19/97
8	3,718	03/19/02	4,760	03/17/01	7,286	03/16/00	394	03/25/99	2,211	03/20/98	1,764	03/20/97
9	1,672	03/20/02	3,024	03/18/01	3,236	03/17/00	177	03/26/99	1,261	03/21/98	1,156	03/21/97
10	2,624	03/21/02	2,531	03/19/01	2,275	03/18/00	184	03/27/99	809	03/22/98	1,916	03/22/97
11	756	03/22/02	4,782	03/20/01	2,108	03/19/00	445	03/28/99	676	03/23/98	984	03/23/97
12 Day Total	758,452		129,346		1,713,491		315,703		226,115		29,113	
5 Day Spill Total	732,430		91,133		1,669,212		311,928		207,578		8,815	
5 Day %	96.6%		70.5%		97.4%		98.8%		91.8%		30.3%	

----- no counts taken, no data available

bolded dates are first and last days of spill

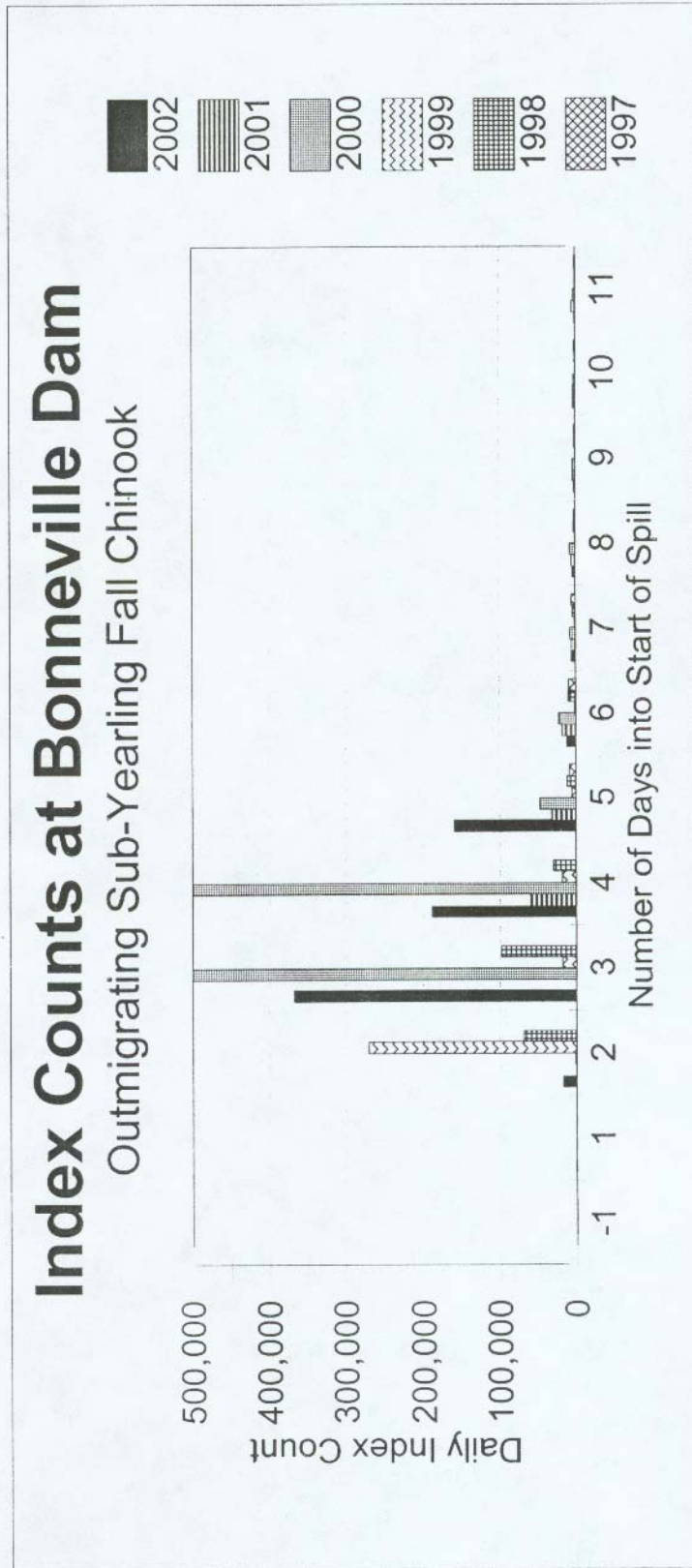


Figure 2. Fish passage index counts before and during spill periods at Bonneville Dam from 1997-2002.

Table 2. Summary of fish sampled for signs of gas bubble trauma (GBT) below Bonneville Dam - March 2002. Three hundred thirty-six fish were examined. One pike minnow had signs of GBT, a single bubble in the caudal fin.

Species	Size Range in mm	# of fish examined for signs of GBT	# of fish with observed bubble in structure			
			DF*	AF*	CA*	EY*
Chum	35-67	50	0	0	0	0
Coho	35-116	43	0	0	0	0
Chinook	44-145	181	0	0	0	0
Northern Pike Minnow	56	1	0	0	1	0
Rainbow Trout	182	1	0	0	0	0
Sculpin	38-124	3	0	0	0	0
Stickleback	29-148	50	0	0	0	0
Whitefish	128-176	7	0	0	0	0
Totals		336	0	0	1	0

* DF = dorsal fin, AF = anal fin, CA = caudal fin, EY = eye

Table 3. Total dissolved gas measurements and depth of chum redds, March 12-13, 2002.

Date	Time	Site #	Location	Hydrolab# % TDG	Depth (m) above redd	Temp. °C	Total Flow (kcfs)	Spill (kcfs)	Tailwater (feet)	Skamania % TDG	Warrendale % TDG
12-Mar	10:18 hrs	A	Oregon shore redds	104.6		5.5	148.6	47.9	13.4	101.7	103.1
12-Mar	10:18 hrs	A	Oregon shore redds	104.3		5.5	148.6	47.9	13.4	101.7	103.1
12-Mar	11:42 hrs	A	Oregon shore redds	107.3		5.5	153.8	53.5	13.5	102.2	103.0
12-Mar	12:09 hrs	A	Oregon shore redds	107.6	0.67	-	153.6	53.5	13.6	103.3	103.5
12-Mar	12:21 hrs	A	Oregon shore redds	107.6	0.75	-	153.6	53.5	13.6	103.3	103.5
12-Mar	12:30 hrs	A	Oregon shore redds	107.6		5.6	153.6	53.5	13.6	103.3	103.5
12-Mar	14:44 hrs	A	Oregon shore redds	-	0.66	-	153.8	53.6	13.6	103.9	104.6
12-Mar	16:00 hrs	B	Mainstem (thalweg off Pierce Is.)	104.6		5.7	153.6	53.6	13.6	103.7	105.9
12-Mar	16:15 hrs	A	Oregon shore redds	-	0.71	-	153.6	53.6	13.7	103.7	105.9
13-Mar	10:05 hrs	A	mid chum channel fyke trap	108.7		5.5	197.6	77.6	16.9	102.1	108.6
13-Mar	10:14 hrs	B	Mainstem (Pierce Is.)	109.8		5.5	197.6	77.6	16.9	102.1	108.6
13-Mar	10:30 hrs	A	Oregon shore redds	108.7	1.52	-	197.6	77.6	16.9	102.1	108.6
13-Mar	11:24 hrs	C	northwest lvs Is.	103.5		5.7	201.2	83.9	16.7	102.3	108.5
13-Mar	11:46 hrs	D	lvs gravel bar redd	103.5	1.43	-	201.2	83.9	16.7	102.3	108.5
13-Mar	12:19 hrs	E	Washington old gauge 3 redd	103.5	1.74	5.6	195.7	97.5	16.8	102.9	108.2
13-Mar	12:45 hrs	F	Beacon Rock boat ramp	103.0		5.6	195.7	97.5	16.8	102.9	108.2
13-Mar	13:08 hrs	G	lvs south pilings	103.4		5.6	198.5	100.4	16.9	103.3	108.9
13-Mar	13:24 hrs	H	Mainstem (off N. Bonneville boat ramp)	103.1		5.5	198.5	100.4	16.9	103.3	108.9
13-Mar	13:35 hrs	I	Mainstem (off Tanner Creek)	112.5		5.6	198.5	100.4	16.9	103.3	108.9
13-Mar	13:45 hrs	J	Mainstem (thalweg off Tanner Creek)	113.8		5.5	198.5	100.4	16.9	103.3	108.9
13-Mar	14:01 hrs	A	Oregon shore redds	112.3		5.8	199.9	100.3	16.9	104.7	110.1
13-Mar	14:22 hrs	B	Mainstem (thalweg off Pierce Is.)	111.8		5.5	199.9	100.3	16.9	104.7	110.1
13-Mar	14:53 hrs	K	St Cloud redds	106.0		6.2	199.9	100.3	16.9	104.7	110.1
13-Mar	15:09 hrs	M	Multnomah redds	106.9		6.2	199.6	100.2	17.0	105.2	110.7
13-Mar	15:21 hrs	L	Mainstem (thalweg off Multnomah Creek)	107.4		5.5	199.6	100.2	17.0	105.2	110.7

USFWS Minisonde Hydrolab

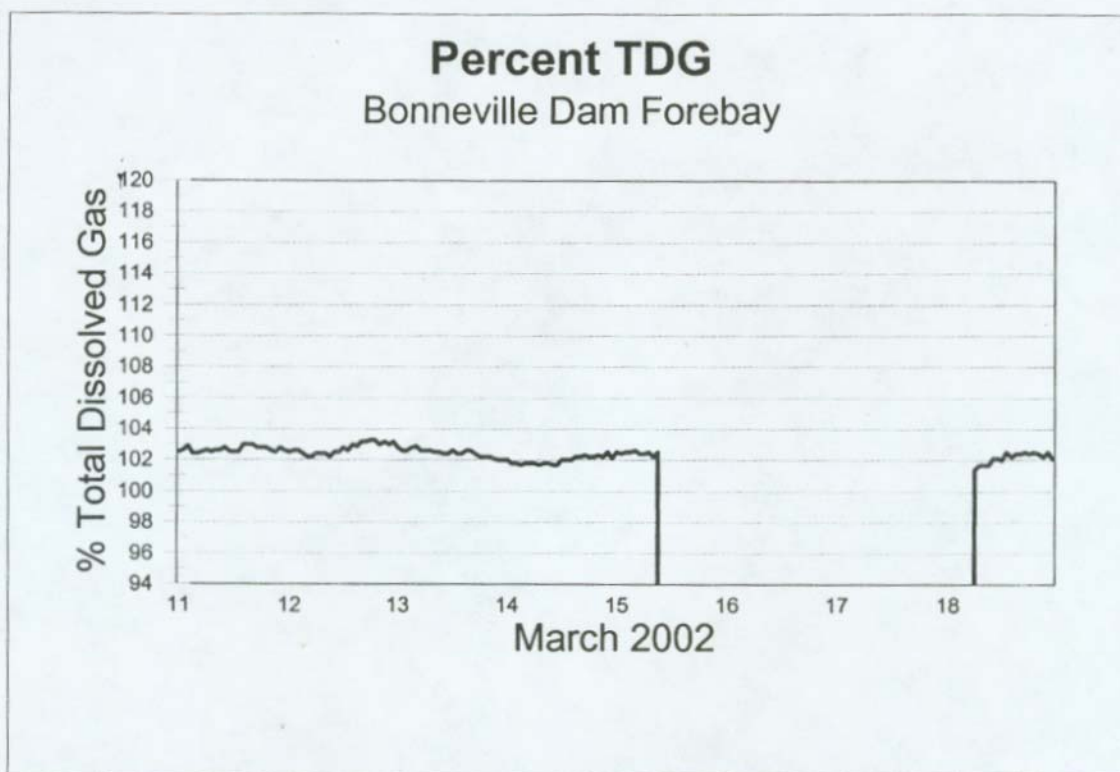


Figure 4. Percent TDG in Bonneville Dam forebay - March 11-18, 2002.

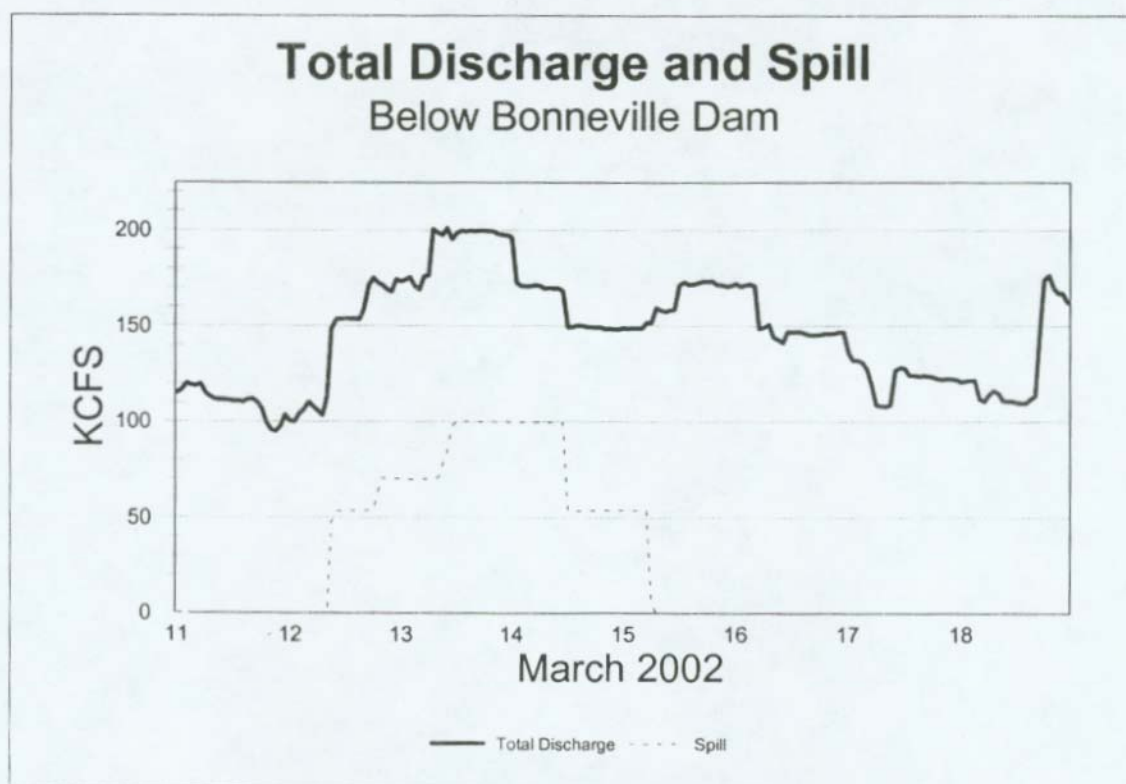


Figure 5. Total discharge and spill from Bonneville Dam - March 11-18, 2002.

Percent TDG

Monitoring Sites Below Bonneville Dam

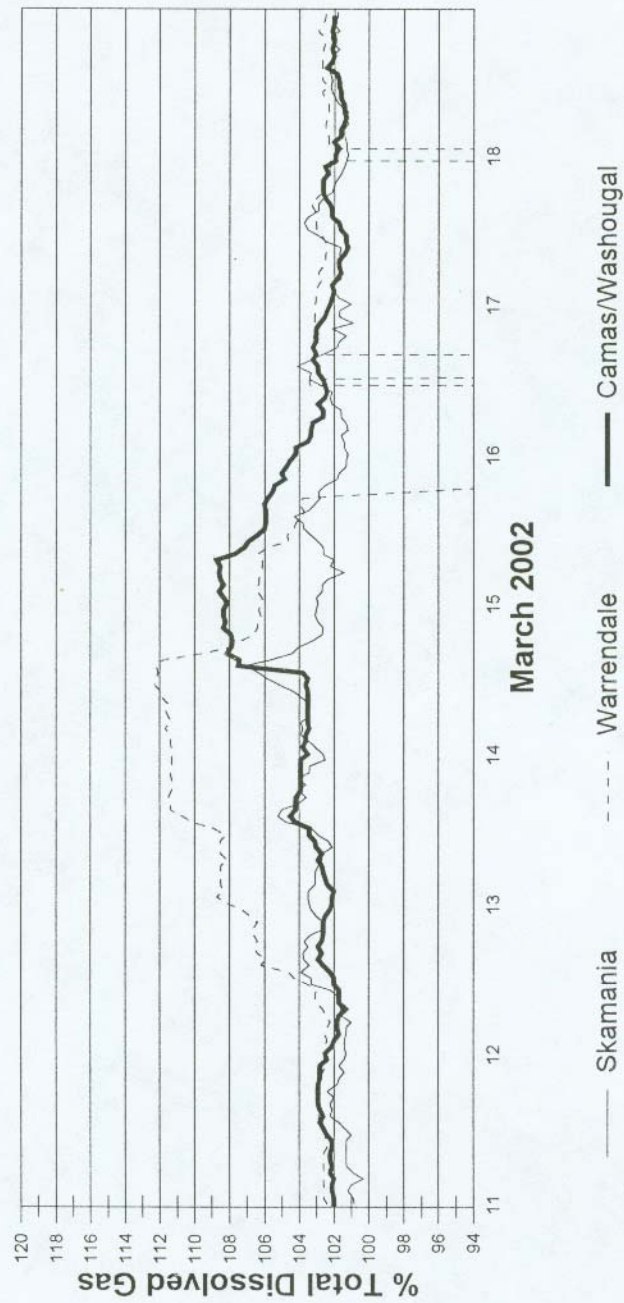


Figure 6. Percent TDG at Skamania, Warrendale, and Camas Washougal monitoring sites, March 11-18, 2002.